Europäisches Patentamt | European Patent Office | Office européen des brevets

Bescheinigung | Certificate | Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

02075031.1

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

DEN HAAG, DEN
THE HAGUE, 02/09/02
LA HAYE, LE

Europäisches Patentamt | European Patent Office | Office européen des brevets

Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

Anmeldung Nr.:
Application no.: 02075031.1
Demande n°:

Anmeldetag:
Date of filing: 08/01/02
Date de dépôt:

Anmelder:
Applicant(s):
Demandeur(s):
Koninklijke Philips Electronics N.V.
5621 BA Eindhoven
NETHERLANDS

Bezeichnung der Erfindung:
Title of the invention:
Titre de l'invention:
Circuit for a gas-discharge lamp

In Anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

Staat: State: Pays:	Tag: Date: Date:	Aktenzeichen: File no. Numéro de dépôt:

Internationale Patentklassifikation:
International Patent classification:
Classification internationale des brevets:
/

Am Anmeldetag benannte Vertragstaaten:
Contracting states designated at date of filing: AT/BE/CH/CY/DE/DK/ES/FI/FR/GB/GR/IE/IT/LI/LU/MC/NL/PT/SE/TR
Etats contractants désignés lors du depôt:

Bemerkungen:
Remarks:
Remarques:

Circuit for a gas-discharge lamp

The present invention relates to a lamp circuit. Such circuits are marketed by applicant with the purpose of making gas-discharge lamps, in particular fluorescent lamps or metal halogenide lamps, function in correct manner. Metal halogenide lamps require for instance a relatively high ignition voltage (about 3500-5000 V), whereafter during the stage of normal operation reached via one or more intermediate stages, the circuit must supply thereto a current of the most constant possible value at an operating voltage of for instance 100 V. Such a lamp has a negative impedance character on a short timescale, therefore it must be current controlled.

Such lamps and associated circuits have now proven their market value, particularly in shopping centers, public buildings and the like, as a result of their relatively high light output. However, the known circuits are in some respects complicated and voluminous, which is undesirable in terms of component and fabrication costs.

The present invention provides a circuit for a lamp, comprising:

- a first sub-circuit for connecting to mains voltage of a predetermined frequency for rectifying the mains voltage;
- a second sub-circuit connected to the first sub-circuit for providing an alternating current required for the lamp; and
- a control circuit which is connected to the first and second sub-circuit and which controls the frequency of the alternating current subject to a varying component of the mains voltage rectified by the first sub-circuit.

Owing to the present invention such a circuit can take a simpler and less voluminous form since a buffer capacitor in such a circuit can be reduced considerably in size, for instance by a factor of ten. The currently available electrolyte capacitors, which as a result of drying-out may have a limited lifespan, can moreover be replaced by more robust film capacitors with smaller capacity values.

The first sub-circuit preferably comprises a so-called pre-conditioner which, generally speaking, comprises a filter with one or more coils and capacitors, a rectifier circuit such as a bridge rectifier in combination with a boost converter or a flyback converter

comprising an (electronic) switch, and a buffer capacity that is coupled to the output terminals.

In a further preferred embodiment, the second sub-circuit comprises a converter circuit for stabilizing direct current and a switching device for providing a square-wave current of a desired level of for instance +/-100 V for normal operation of the lamp.

In a further preferred embodiment the control circuit is connected on one side to an (electronic) switch in the first sub-circuit and on the other side to one or more (electronic) switches in the switching device part, so that the phase and/or frequency of the lamp current controlled by the commutator is controlled subject to a varying component of for instance 50 Hz or a multiple thereof (for the USA and Japan 60 Hz or a multiple thereof).

In a further preferred embodiment of the present invention the frequency of the alternating current provided by the second sub-circuit is made the same as the frequency of a varying component of the mains voltage rectified by the first sub-circuit.

In a further preferred embodiment of the present invention the control circuit controls the phase of the alternating current provided by the second sub-circuit such that this is the same as the phase of a varying component of the rectified mains voltage provided by the first sub-circuit.

These and other aspects of the invention are explained hereinbelow with reference to associated figures, in which:

Fig. 1 shows a block diagram of a circuit for a lamp according to a preferred embodiment of the present invention;

Fig. 2 shows a diagram of a part of the circuit of fig. 1 according to a preferred embodiment;

Fig. 3 shows a diagram of a part of the circuit of fig. 1 according to a further embodiment;

Fig. 4 shows a diagram of a part of the circuit of fig. 1 according to a further embodiment; and

Fig. 5 shows a graph with voltage and current values varying in time in the circuits of figs. 1-4 as elucidation of the operation thereof.

Fig. 1 shows a circuit for a lamp 1 having included therein a pre-conditioner 2 which has the function of rectifying the supplied alternating voltage u_i and bringing it to a desired voltage level. Depending on the requirements made of the current drawn from the mains 3, concerning the power factor and the harmonical distortion thereof, the component values of the pre-conditioner are adapted. Adding an interference filter 4 can further support in meeting these requirements. Part of the pre-conditioner is an energy buffer 5 to which the subsequent sub-circuits are connected. Provided across the energy buffer 5 is the rectified voltage U_{DC} with a value in the order of an average of 400 V, to which is connected a stabilizer 6 for stabilizing direct current supplied to a commutator 7, in which an igniter 8 for igniting lamp 9 is arranged. Commutator 7 provides for instance a square-wave current i_c to lamp 9, for instance a metal halogenide lamp with an output of 80 lm/W and a lifespan in the order of 10,000 hours, with u_9 the voltage over the lamp. Such lamps, that use such an electronic circuit, are supplied by applicant with type designations MH and CDM in the power range of 35-150 W. Control circuit 10, which is connected to pre-conditioner 2, stabilizer 6 and commutator 7, controls these sub-circuits so as to provide the above-stated properties. The light level can be controlled (dimming) by the externally available light level control 11.

Fig. 2 shows a more detailed diagram of circuit 1, representing the preferred embodiment of the invention, having indicated therein the mains voltage 3 to which the circuit is connected, followed by an interference filter 4 consisting of coils 13 and 14 and capacitor 15. Pre-conditioner 2 comprises the double-sided rectifier 16 followed by coil 17 and FET 18. After opening of the FET the coil 17 will want to maintain the current thereover by generating a voltage, resulting, via the diode 19, in a direct voltage U_{DC} across the buffer capacitors 20 and 21, that perform the task of buffer capacitor 5 in fig. 1. At the connection 22 between capacitors 20 and 21 the voltage value is (0.5 U_{DC}). In the preferred embodiment as shown in fig. 2, the stabilizer, commutator and buffer capacitor are combined in one circuit 23, the so-called half-bridge commutating forward (HBCF) 23. The HBCF comprises FETs 24 and 25, that are made alternately conducting or non-conducting in a determined frequency by control circuit 10, whereby the voltage $u_{22,26}$ over the points 22 and 26 of the circuit is alternately plus or minus half the rectified voltage. Coil 27 is present to provide a stabilized current to the series connection of lamp 9 and coil 30. The coil 30 in combination with capacitor 31 thereby filters the varying component of the load current provided by coil 27. Diodes 28 and 29 are provided parallel to the FETs 24 and 25 to release stored energy from coil 27. To ignite the lamp 9, an igniter, that is further not shown, is coupled via a

transformer connection to coil 30 during starting of the lamp 9, whereby the igniter co-acts with capacitor 31.

A further possible embodiment of the invention concerns a full-bridge commutating forward (FBCF) 36 as shown in fig. 3, comprising four FETs 24, 25, 32 and 33. Alternately, FET 24 and 33 are made conducting or non-conducting and FETs 25 and 32 are made non-conducting or conducting respectively. Buffer capacitor 5 in this case is present to supply the rectified voltage, so the entire rectified voltage U_{DC} is provided across points 22 and 26 of the circuit.

In still a further embodiment of the invention (fig. 4), the stabilizer and commutator are implemented separately as the down converter 37 and the full-bridge commutator 38. The down converter comprises a FET 39, diode 40, coil 41 and capacitor 42, whereby the FET 39 is turned on and off by the control circuit 10. The FETs 24 and 33 and the FETs 25 and 32 are made alternately conducting or non-conducting respectively.

Fig. 5A and 5B herein show the voltages at different locations in the circuit. The mains voltage is 220 V - 240 V at a frequency of about 50 Hz - 60 Hz (fig. 5A). The rectified voltage U_{DC} (fig. 5B) on the buffer capacitor has an average voltage level of for instance 400 V, wherein the varying component present thereon has a fundamental frequency of 100 Hz - 120 Hz with a peak-to-peak value which depends on the capacitance of the buffer capacitor 20 + 21 (fig. 2) or 5 (fig. 3 or 4). This varying component has a peak-to-peak value of for instance 10 V at a buffer capacitance of 68 μF and of for instance 100 V at a buffer capacitance of 6.8 μF in case the load is a 70 W lamp.

When the HBCF circuit is used (fig. 2), half of U_{DC} is provided across the series of coils 27 and 30 and lamp 9. The lamp current i_9 (fig. 5C) is a square-wave current with a value of about 0,8 A if loaded with a 70 W lamp. The voltage u_9 over the lamp 9 is shown in fig. 5D, with a value of about 100 V. After the moment of commutation, i.e. the moment the current changes direction, there will however occur a so-called restart peak 51, wherein for a short time the voltage over the lamp assumes a higher value in the order of 150 V (fig. 5D). If the supplied voltage, the available open circuit voltage, is now lower than the voltage of this restart peak, the lamp will go out.

The control circuit controls the FETs such that the square-wave current applied to the lamp is synchronized with the voltage over the buffer capacitor, wherein the square-wave current has a frequency which is the same as the fundamental frequency of the varying component of supply voltage U_{DC} This means that at the moment of commutation the voltage available to the lamp will always equal (half) the mean value of the supply voltage

U_{DC}, the Open Circuit Voltage (OCV), and is guaranteed, so that during the commutation the OCV will always have a value greater than the necessary re-ignition voltage of the lamp. The lamp circuit can hereby be optimized by reducing the size of the energy buffer, wherein the lifespan and the reliability of the circuit and of the lamp are also improved.

A circuit for a lamp according to the present invention provides an optimized circuit, concerning both the requirements made of the current drawn from the mains by using a pre-conditioner and concerning the open-circuit voltage that is available to the gas discharge lamp. The capacitance of the buffer capacitor can thereby be reduced, wherein the lifespan of the circuit and the lamp is increased and the size of the circuit is reduced. The lamp will herein burn reliably, since the open circuit voltage available to the lamp is always greater than the voltage demanded by the lamp.

The present invention is not limited to the above described preferred embodiment thereof; the rights sought are however defined by the following claims, within the scope of which many modifications can be envisaged.

CLAIMS:

1. Circuit for a lamp, comprising:

- a first sub-circuit for connecting to mains voltage of a predetermined frequency for rectifying the mains voltage;

- a second sub-circuit connected to the first sub-circuit for providing an alternating current required for the lamp; and

- a control circuit which is connected to the first and second sub-circuit and which controls the frequency of the alternating current subject to a varying component of the mains voltage rectified by the first sub-circuit.

2. Circuit for a lamp as claimed in claim 1, wherein the first sub-circuit comprises a filter with one or more coils and capacitors, a rectifier circuit, an (electronic) switch and a buffer capacitor that is coupled to its output terminals.

3. Circuit for a lamp as claimed in claim 1 or 2, wherein the second sub-circuit comprises a converter circuit for stabilizing direct current and a switching device for providing a square-wave current of a desired level of for instance +/-0,8 A for normal operation of the lamp.

4. Circuit for a lamp as claimed in claim 1, 2 or 3, wherein the control circuit is connected on one side to an (electronic) switch in the first sub-circuit and on the other side to one or more (electronic) switches in the switching device, so that the phase and/or frequency of the lamp current controlled by the switching device is controlled subject to a varying component of for instance 50 Hz or a multiple thereof (in the USA and Japan 60 Hz or a multiple thereof).

5. Circuit for a lamp as claimed in claims 1-4, wherein the frequency of the alternating current provided by the second sub-circuit is made the same as a varying component of the mains voltage rectified by the first sub-circuit.

6. Circuit for a lamp as claimed in claims 1-5, wherein the control circuit controls the phase of the alternating current provided by the second sub-circuit such that this is the same as the phase of a varying component of the rectified mains voltage supplied by the first sub-circuit.

7. Circuit for a lamp as claimed in claims 1-6, wherein the second sub-circuit comprises an igniter for generating voltage pulses across the lamp so as to ignite the lamp.

8. Circuit for a lamp as claimed in claims 1-7, wherein the rectified mains voltage is in the order of magnitude of 400 V and the voltage across the lamp is in the order of magnitude of 100 V to 150 V.

9. Circuit for a lamp as claimed in claims 1-8, wherein the varying component of the rectified mains voltage has a peak-to-peak value in the order of magnitude of 10-100 V.

10. Method for operating a lamp, comprising the steps of:

- rectifying a supplied mains voltage and bringing it to a desired voltage level; and

- generating an alternating current;

wherein the frequency of the alternating current is controlled subject to a varying component of the rectified mains voltage.

11. Method for operating a lamp as claimed in claim 10, wherein the phase of the alternating current is the same as the phase of the varying component of the rectified mains voltage.

ABSTRACT:

The invention relates to a circuit for a discharge lamp, comprising:

- a first sub-circuit for connecting to mains voltage of a predetermined frequency for rectifying the mains voltage;
- a second sub-circuit connected to the first sub-circuit for providing an alternating current, preferably a square-wave current, required for the lamp; and
- a control circuit which is connected to the first and second sub-circuit and which controls the frequency of the alternating current subject to a varying component of the mains voltage rectified by the first sub-circuit.

Fig. 1

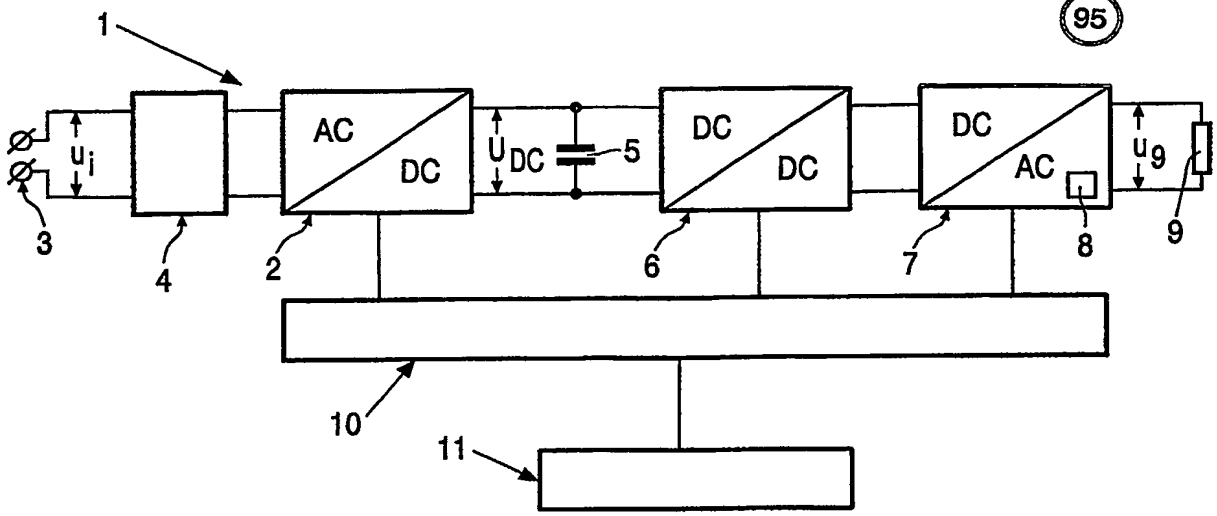

FIG. 1

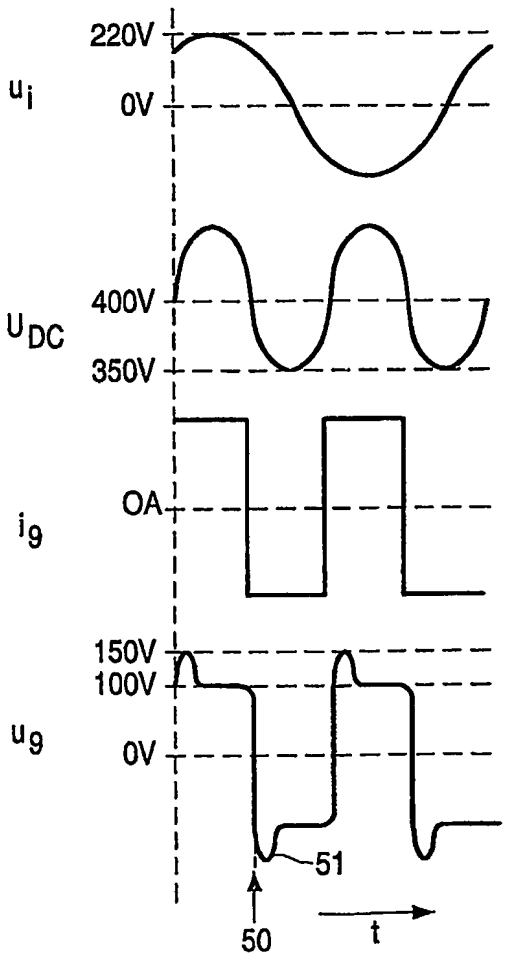

FIG. 5A

FIG. 5B

FIG. 5C

FIG. 5D

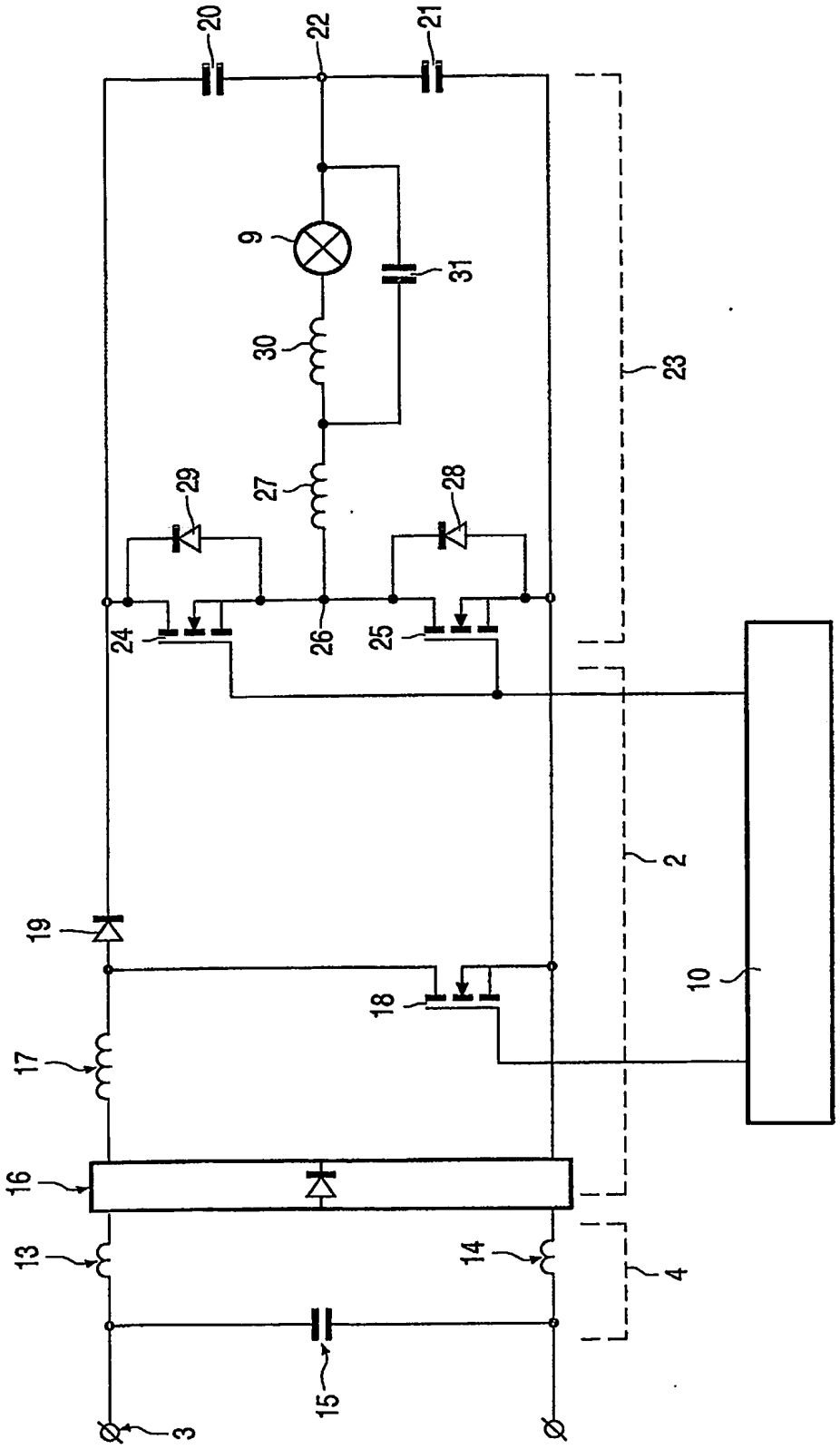

FIG. 2

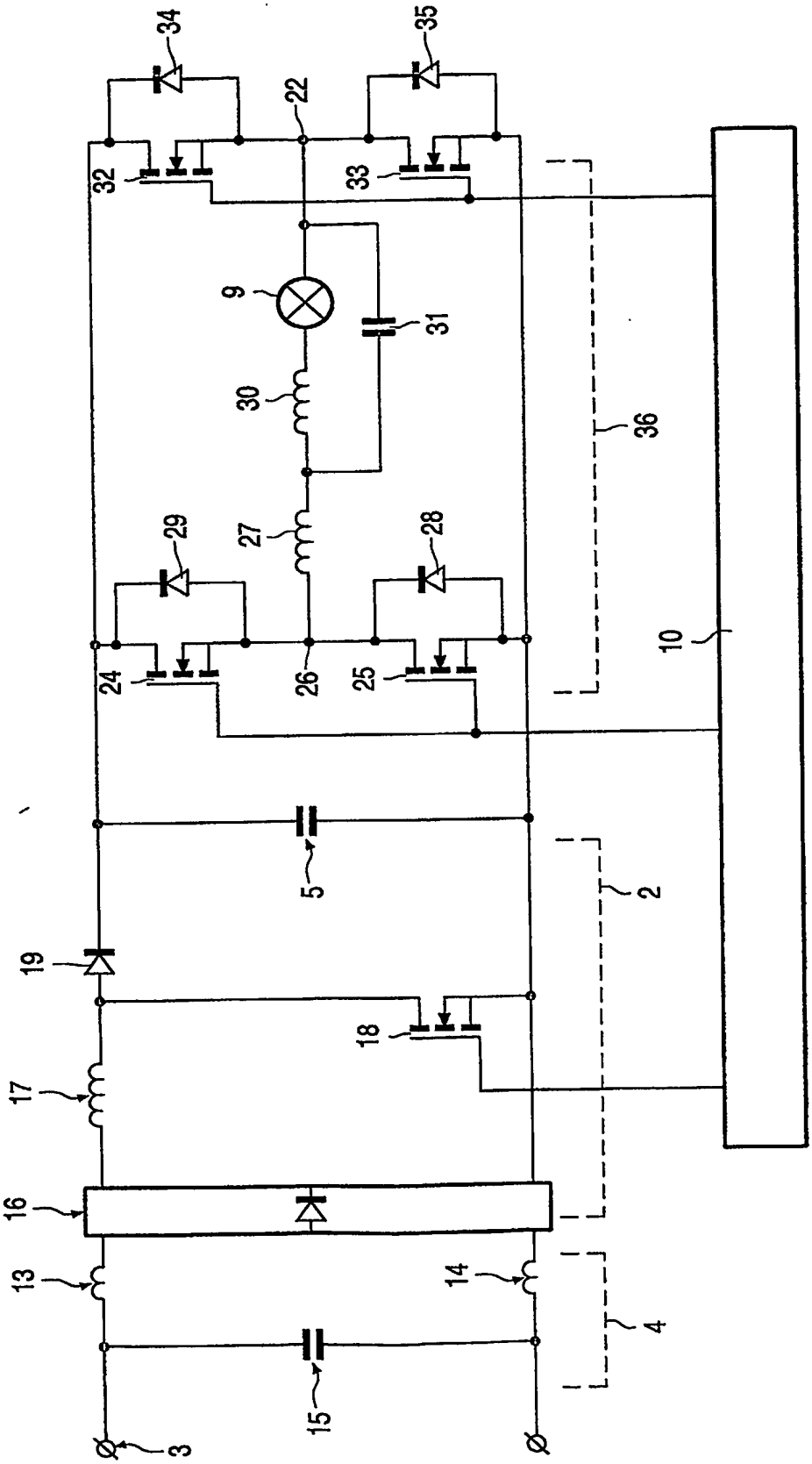

FIG. 3

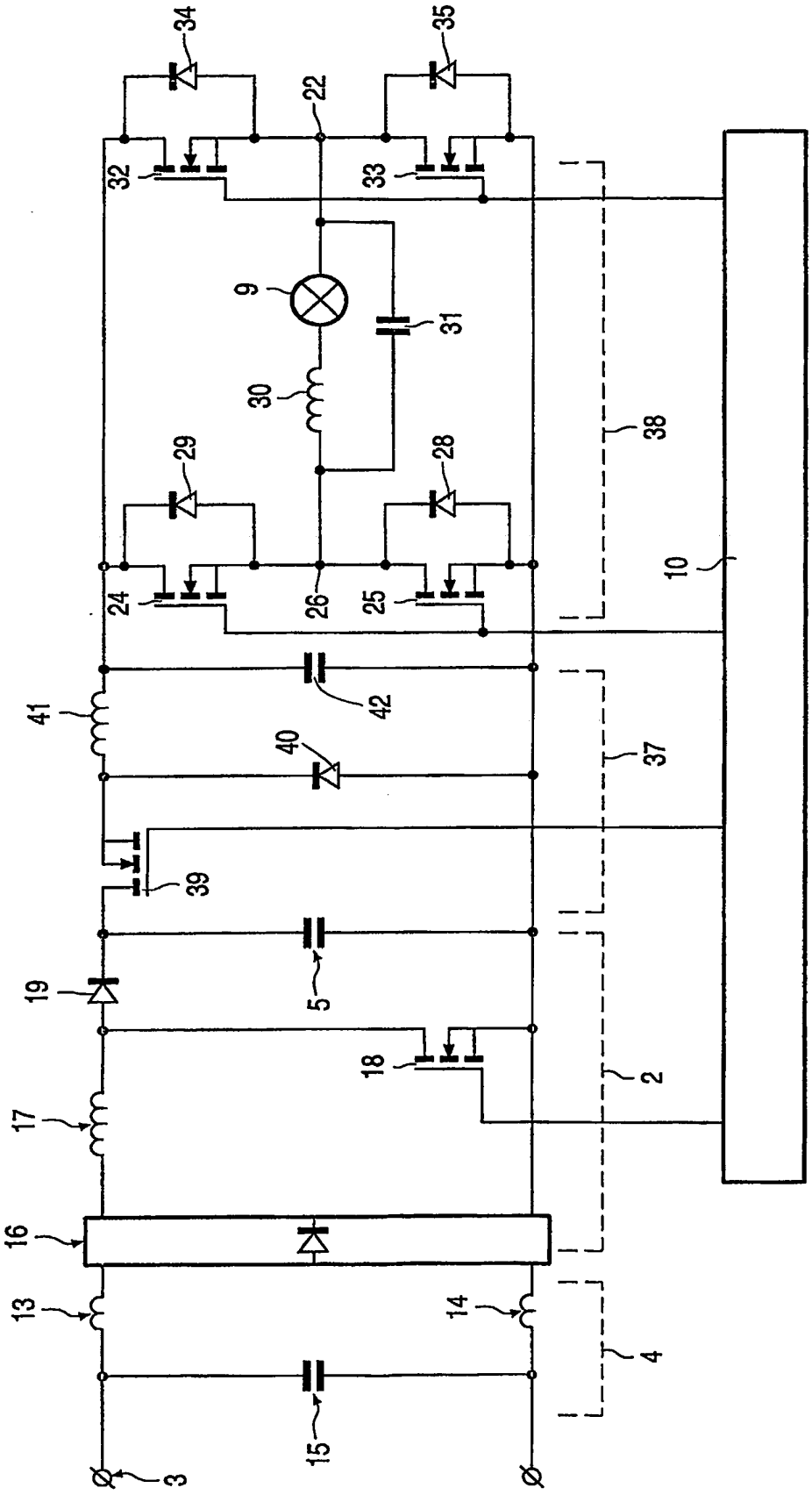
34
35
22
32
33
9
31
30
29
28
38
10
24
26
25
42
41
40
37
39
5
19
18
2
17
16
13
14
4
15
3

FIG. 4